# Space Weather Technical Forecast

Issued on Saturday, 11 June 2022 at 13:22 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: Slight chance of further M-class flares.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity was Low in the last 24 hours, with only a couple of C-class flares that seemed to originate from one of the two regions located near the northeastern limb. These occurred right at the beginning of the period, after what the activity became subdued. There are currently up to four sunspots on the visible disc, two of which are moderately complex and developing bipolar regions.

A filament lift-off was seen leaving the northwestern quadrant of the sun at around 10/1630UTC on H-Alpha imagery (such as El Teide). A very faint ejecta was observed on coronagraph imagery, it may well be Earth-directed but its velocity is estimated to be low. No other CMEs were observed.

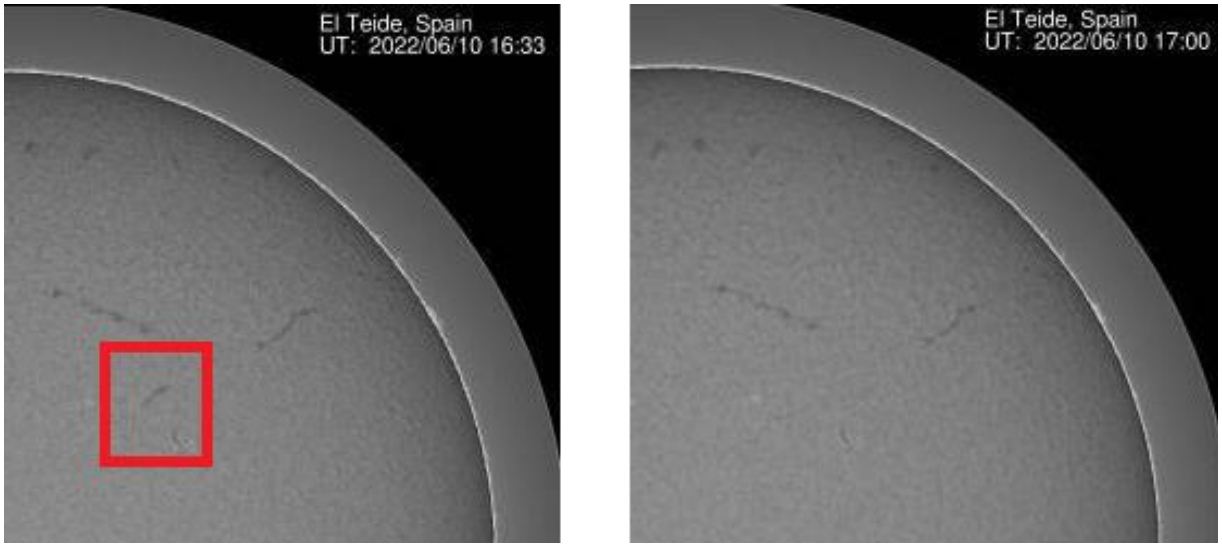


**Figure 0: H-Alpha imagery of disappearing filament in northwest quadrant around 10/1630UTC. There is not yet any evidence that this feature left the immediate solar environment, however it will be monitored.**

**Solar Wind / Geomagnetic Activity:** The solar wind, as observed by DSCOVR and ACE at L1, has been slow-ambient during the last 24 hours, between 300-330 km/s, but its density has constantly risen, increasing from 6 ppcc to around 20 ppcc, perhaps indicating the arrival of a high speed stream. Total interplanetary magnetic field strength has been weak (peaking at just 8nT around 11/0520 UTC), with only small variations in the north-south component. The phi angle was largely negative (towards the sun) but became positive (away from the sun) at times during the second half of the period.

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The overall effect of the above solar wind measures on geomagnetic activity was mostly Quiet with one provisional Unsettled interval between 11/0600-0900 UTC.

**Energetic Particles / Solar Radiation:** The high energy proton flux (10 MeV) was at Background levels.

Electron flux (greater than 2MeV) was largely within Normal Background levels. Corresponding 24-hour integrated electron fluence has been well below the Active (1e8 integrated pfu) threshold on a slightly rising trend, finishing the 24 hours with an observed value of 1.83e6 integrated pfu at 10/2400UTC.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Solar activity is expected to be mainly Low over the following days, with C-class flares and a slight chance of M-class flares. However a bright flux region can be observed on satellite imagery, suggesting further sunspots are likely to rotate onto the earth-facing disc in the coming days, leading to an increasing risk of flares.

**Solar Wind / Geomagnetic Activity:** A filament lift-off was seen leaving the sun at around 10/1630UTC. The results of its analysis are not fully known yet but it may be Earth-directed and could arrive at Earth on Day 4. No other Earth-directed CMEs were observed. Recent STEREO A measurements echoed by Enlil suggest a high speed stream as potentially arriving on Day 2. Overall geomagnetic activity is expected to be mainly Quiet on Day 1 but Quiet to Unsettled on Days 2 to 4, with a slight chance of Active intervals on Day 4.

**Energetic Particles / Solar Radiation:** High energy proton flux (greater than 10 MeV) is expected to be at Background levels during this period.
High energy electron flux (greater than 2 MeV) is expected to vary between Normal Background and Moderate levels. Electron fluence is expected to remain below the Active threshold throughout, with probably a slight upward trend in fluence levels during the period, mainly in the wake of any uptick from an expected weak coronal hole.

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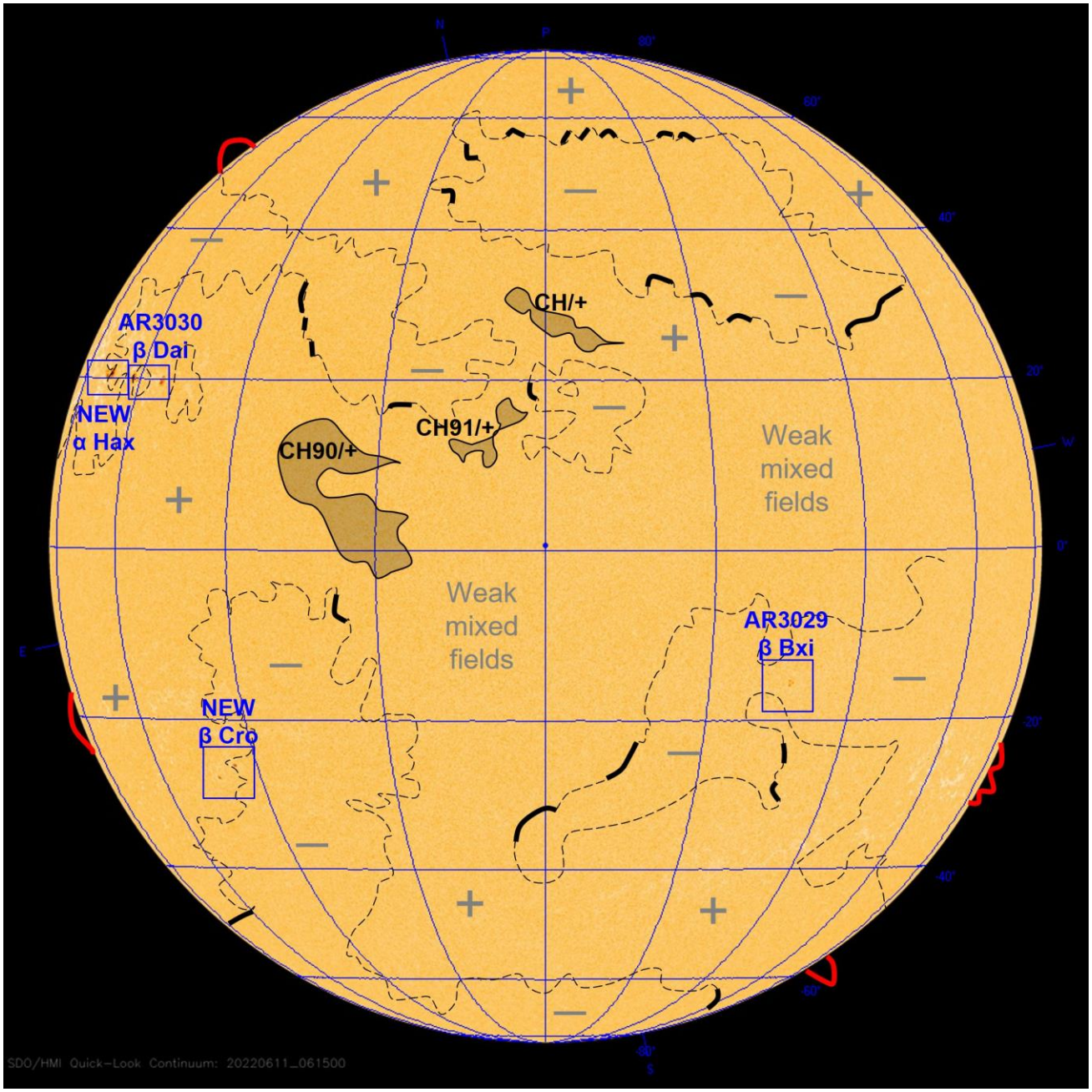
**Figure 1. Solar Analysis Valid 11/0800 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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# Met Office Space Weather Technical Forecast

## Geomagnetic Storms:

A filament lift-off was seen leaving the northwestern quadrant of the sun at around 10/1630UTC. We are currently awaiting the results of the analysis, however its velocity is estimated to be slow. Should it be Earth-directed, its impact on the Earth's magnetic field should most likely be limited, due to our proximity of the summer solstice, and expected to be seen on Day 4. No other Earth-directed CMes were observed on satellite imagery.

Solar winds are expected to be mainly at background levels initially, with no significant coronal holes over the western hemisphere. Some slight enhancements are possible though, due to the presence of small and transient coronal holes, for instance CH89/+ that was observed a few days ago or the small feature that currently sits on the central meridian. While not evident on current AIA193 imagery, historically there has also been a small coronal hole visible in the northwest quadrant with a larger analogue from previous rotations. This may be the cause of a recent increase in the observed solar wind speed at STEREO-A spacecraft, near 500km/s, an increase that is also suggested by the latest MOSWOC Enlil modelling.

Overall geomagnetic activity is expected to be mainly Quiet on Day 1 but Quiet to Unsettled on Days 2 to 4, with a slight chance of Active intervals on Day 4.

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 1 | 1 | 5 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

None at time of issue - Awaiting results of the analysis

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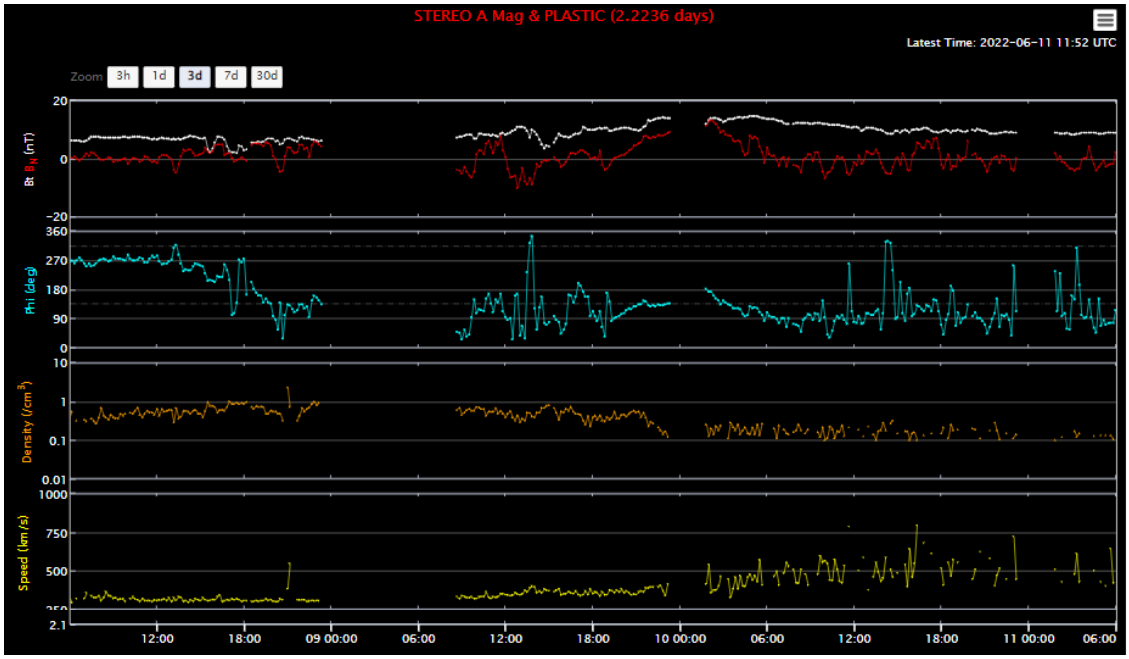
**Figure 2: 3-Day STEREO A MAG and PLASTIC trace showing enhancement in solar wind speed as affecting the satellite at present. The speed trace is particularly noisy, however is perhaps suggestive of a fast wind of around 500km/s.**




## Radio Blackouts - X-Ray Flares:

Solar activity was Low in the last 24 hours, with only a couple of C-class flares that seemed to originate from one of the two regions located near the northeastern limb. These occurred right at the beginning of the period, after what the activity became subdued.

There are currently up to four sunspots on the visible disc, two of which are still unnumbered. One of them is a unipolar spot near the northeastern limb that seems to be part of a large plage region. Right next to it is AR3030, currently Beta/Dai, a region that is slightly growing, with the appearance of one, perhaps two intermediate spots, but the narrow viewing angle could be misleading. The other unnumbered region, located in the southeastern quadrant, has recently developed and consists of two spots with rudimentary penumbra, classified as Beta/Cro. It is growing faster than the other regions. Finally, in the southwestern quadrant is AR3029 a mature and now decaying unipolar region that will most likely vanish in the next 6-12 hours.

All considered, the northeastern limb remains an area to watch, with an increase in X-ray activity posited for the outlook period, supported by recent flares, CMEs and STEREO A EUVI 195 imagery. This region of the sun contains the remnants of Ex-3014 and Ex-3017, which gave M and X class flares on their last foray onto the front side, and it remains to be seen whether they remain capable of similar given there presumed maturity.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 25 | 30 | 35 | 40 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| **Very Active** | **R3 to R5 X Class** | No | 2 | 3 | 5 | 10 |

**Figure 3: Cylindrical projection of the sun in 195 Angstroms, showing impending bright flux regions over the northeastern and perhaps later southeastern solar horizon. The northern feature in particular perhaps offers a higher chance of generating X-ray activity given its history.**

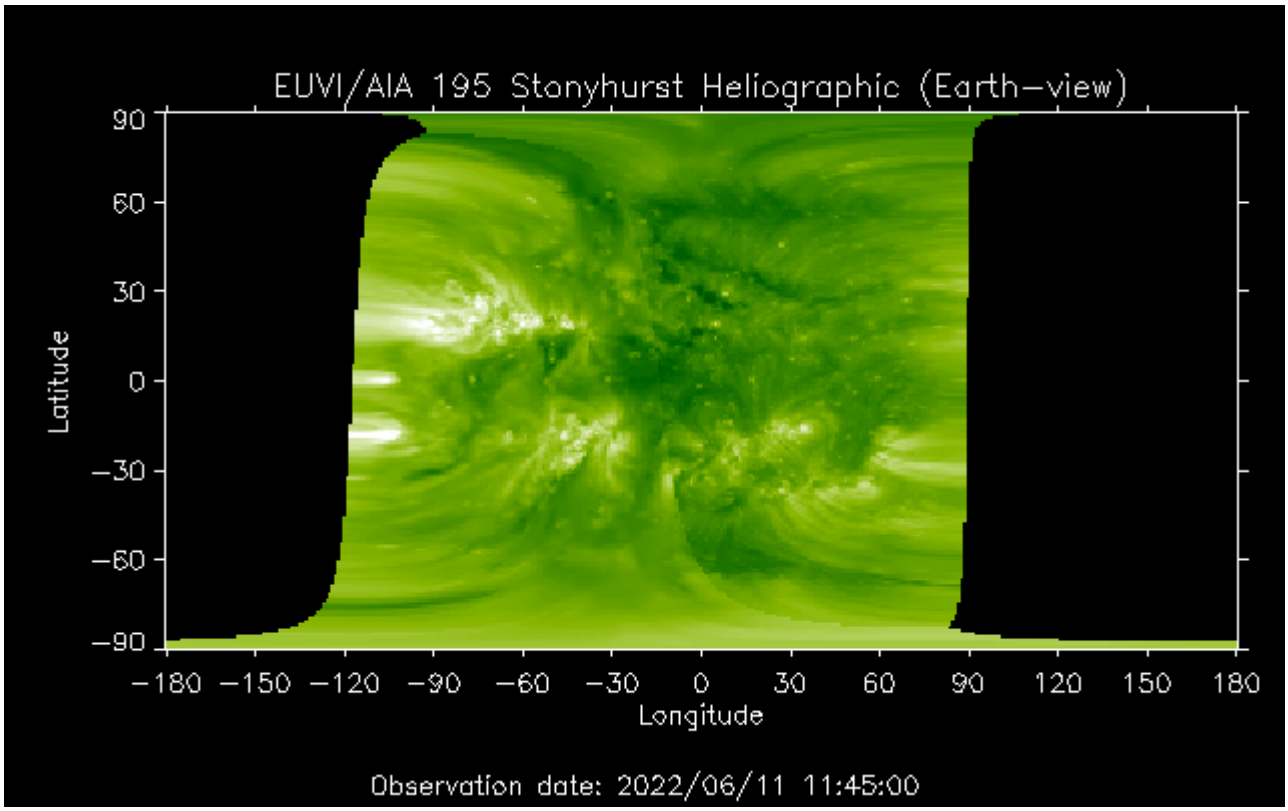


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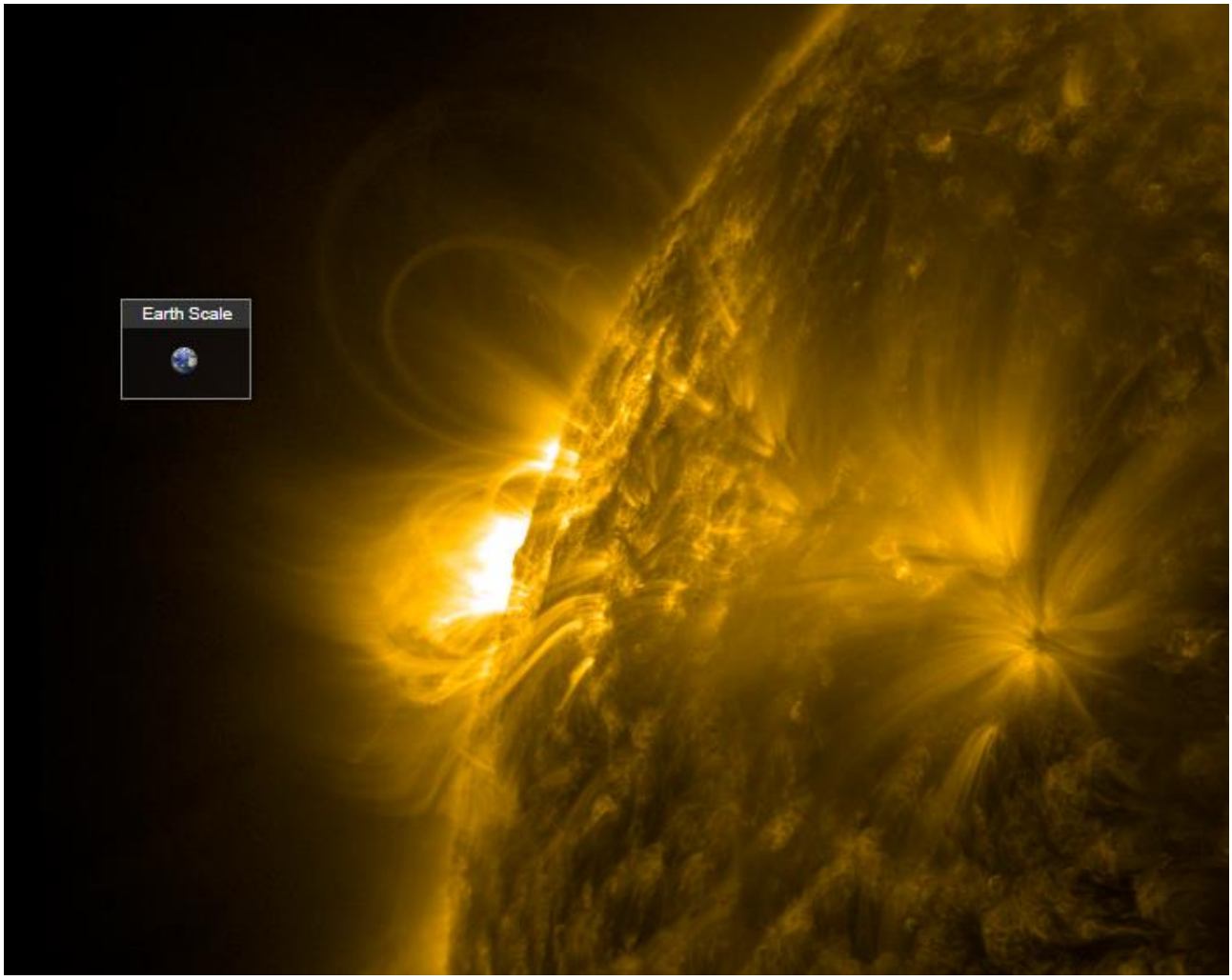
**Figure 4: Helioveiwer.org-generated composite image from 11/1150UTC showing AIA 171 imagery. The bright flux region coming from the far side highlights the presence of a potentially complex region, waiting to rotate over the northeastern limb. Also shown is the Earth for scale.**




## Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at Background levels and is expected to remain at this level through the period in the absence of significant sunspot regions in the western hemisphere.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 1 | 1 | 1 | 1 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

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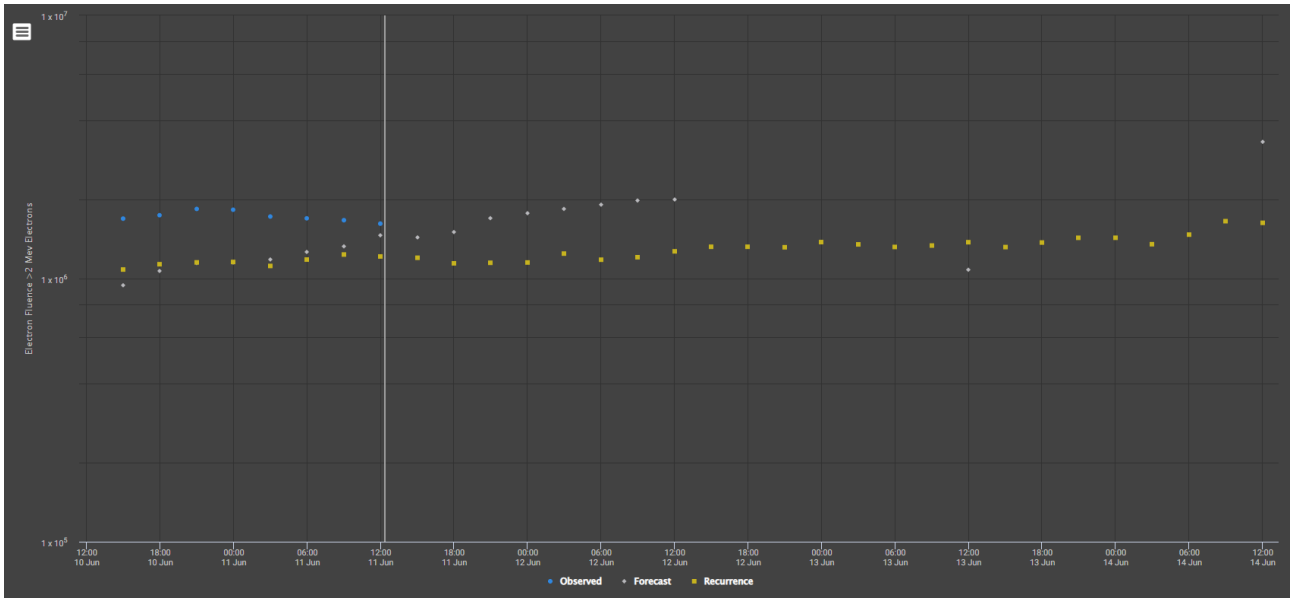
**High Energy Electrons Event (≥ 2MeV):**
High energy electron flux (greater than 2MeV) is expected to remain at mainly Normal Background levels through the next four days, perhaps with a slightly rising outlook as a result of any influence from what is presumed to be minor coronal hole 87, as seen at STEREO A in recent hours. This is unlikely to prove capable of generating Active electron fluence, and current MOSWOC REFM guidance is accepted in its rising, but comfortably sub-Active 72-hour forecast trend.

| GEO Electron Environment<br>Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 1 | 1 | 10 | 20 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

**Figure 5: Latest MOSWOC REFM forecast (white dots), observed 24-hour fluence values (blue dots) and persistence 24-hour fluence (yellow dots). All are in good agreement, and the slight trend upwards in the 72 hours is accepted.**

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